UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/604,154	06/27/2003	Yong Zhou	GEMS8081.144	1153

27061 7590 09/14/2007

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (GEMS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

EXAMINER	
ABRAHAM, SALIEU M	

ART UNIT	PAPER NUMBER
3768	

NOTIFICATION DATE	DELIVERY MODE
09/14/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

info@zpspatents.com
rlt@zpspatents.com
klb@zpspatents.com

Office Action Summary	Application No.	Applicant(s)	
	10/604,154	ZHOU, YONG	
	Examiner	Art Unit	
	Salieu M. Abraham	3768	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 June 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 June 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 9 is objected to because of the following informalities: The claim as currently written is confusing and does not convey the proper order and application of the predetermined peripheral region to k-space center transitional delay in a clear manner. While examiner understands from applicant's amendment the assertion that the terms "first peripheral region" and "second peripheral region" can be interpreted or understood as "merely identifiers", this phrasing as it currently stands can also be interpreted differently. For example, it may also be interpreted to be order specific because of the "identifiers" "first" and "second". The claim language can be made clearer so as to avoid confusion. Examiner strongly recommends the claim be amended as shown below.

In the claim:

Claim 9 in line 2 after "delay time" delete "after sampling a first peripheral region is a multiple of that observed after sampling of a second peripheral region" and insert ----- observed after sampling of a second peripheral region is a multiple of that after sampling a first peripheral region -----.

2. The indicated allowability of claims 2-3, 6-7, 10-11, and 13-21 is withdrawn in view of the newly applied reference(s) to Jezzard and Rose. Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,713,358 to Misretta (Misretta) in view of U.S. Patent Application Pub. No. US 2003/0032877 to Watts (Watts) further in view of US Pat. No. 6,815,952 to Rose (Rose).

In Reference to Claim 1

Misretta teaches:

A method of MR data acquisition comprising the steps of:

a. "sampling peripheral regions of k-space at a pre-selected temporal rate" (see Misretta abstract and column 11, lines 55-59 and 62-63);

b. "wherein the ***center region is sampled at a higher temporal rate***; ***otherwise sampling the next region of k-space at the pre-selected temporal rate***" (see Misretta column 3, lines 56-62, column 4, lines 2-18, column 7, lines 65-67 and column 8, lines 19-27)).

However, Misretta does not teach: "waiting a ***predetermined period*** of time before sampling a next region of k-space if the next region of k-space is a center region of k-space".

Watts teaches: "waiting a ***predetermined period*** of time before sampling a next region of k-space if the next region of k-space is a center region of k-space" (see Watts, page 10, claim 23) in order to obtain higher fidelity image data when acquiring k-space center that directly impacts reduction/minimization of time-resolved contrast kinetics-based and fast MR image noise (see Watts page 2, section/paragraph [0018]) and improves overall image quality (see Watts abstract, page 2, section [0027], lines 6-11, and Conclusion/section [0103], lines 1-4).

However, Misretta in view of Watts does not explicitly teach "and wherein the predetermined period of time is a function of peripheral region distance from the center region of k-space.' Misretta in view of Watts does teach "otherwise sampling the next region of k-space at the pre-selected temporal rate", as this a part of the 3D-

TRICKS protocol disclosed in the reference (see column 7 lines 65-67 and column 8, lines 1-53).

Rose teaches of diffusion imaging with eddy-current compensation in order to achieve improved imaging through optimization of "signal to noise ratios (SNRs) while avoiding distortions due to eddy-current induced magnetic fields." He cites that large gradients are involved in diffusion tensor imaging which impede image signal and boost distortion/noise (see column 1, lines 24-31). He further discloses (and it is well known in the MRI art) that gradient magnitude has a direct bearing on the distorting eddy-current induced magnetic fields (see column 3, lines 35-67) and that delays before k-space center sampling can be used to minimize or allow the distortion effects to play out (see column 3, lines 35-67, column 7 lines 8-30, claim 12).

It is further well known in the MRI art that in traversing k-space, larger gradients correlate with traversing or moving out to regions of k-space that are further away from k-space center. The image distortion effects resulting from the application of these large gradients and time delay compensation for them are also well known in the art; particularly with regard to eddy-current compensation as noted by Rose.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "and wherein the predetermined period of time is a function of peripheral region distance from the center region of k-

space" of Rose in the method of Misretta in view of Watts in order to optimize SNR and avoid eddy-current induced image distortions as explicitly taught by Rose (see column 1, lines 24-31).

5. Claims 3 - 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,713,358 to Misretta (Misretta) in view of U.S. Patent Application Pub. No. US 2003/0032877 to Watts (Watts) further in view of US Pat. No. 6,815,952 to Rose (Rose) and further in view of Jezzard, Peter "Physical Basis of Spatial Distortions in Magnetic Resonance Images." in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezzard (Jezzard).

In Reference to Claim 3

Misretta in view of Watts further in view of Rose has been shown to teach all claim 1 limitations. However, Misretta in view of Watts further in view of Rose is silent with regard to "further comprising the step of increasing the predetermined period of time as the peripheral region distance from the center region of k-space increases."

Jezzard, in the same field of endeavor, teaches the application of a delay which is determined by applying dummy acquisitions or scans in order to allow spins to have reached a steady state when the image signal is detected and to curtail non-frequency-

encoded (e.g. phase- and/or slice-encode derived artifact or noise ;see Jezzard, p. 434, section 6.2 "Non-Steady State Effects", and equations 11, 12 and 13).

It is well known in the MRI art that the degree of gradient (frequency, phase and/or slice) encoding determines the region of k-space to be sampled (large gradient encoding enables sampling of regions further from k-space center and vice versa). Jezzard further discloses that dummy scan derived delays be applied in sufficient proportion in order to achieve spin steady state and allow for noise effects to be reduced or eliminated (see p. 434 and equations 11 and 13). It would be readily apparent to one of ordinary skill that greater delays are required in order to achieve noise minimization when going further out from k-space center and vice versa, because larger gradients are used and these generate larger distortion/noise effects as discussed earlier.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included "further comprising the step of increasing the predetermined period of time as the peripheral region distance from the center region of k-space increases" of Jezzard in the method of Misretta in view of Watts further in view of Rose in order to allow for spin steady state conditions and reduction of region-derived image noise as taught by Jezzard (see p. 434, section 6.2 "Non-Steady State Effects", and equations 11, 12 and 13).

In Reference to Claim 4

Misretta in view of Watts further in view of Rose further in view of Jezzard has already been shown to teach all claim 1 limitations.

Jezzard further teaches the method of claim 1 further comprising the step of playing out a series of zero-encoding pulses during the predetermined period of time (see Jezzard, p. 434, section 6.2 "Non-Steady State Effects", and equations 11 and 12) in order to allow "enough dummy excitations (scans) of the spin system" so "that the spins may attain a steady state" as well as minimize or eliminate any "substantial artifacts" or "Fourier Noise" in the reconstructed image that could potentially result from non-steady state conditions.

Therefore, Misretta in view of Watts further in view of Rose further in view of Jezzard teaches all claim 4 limitations.

In Reference to Claim 5

Misretta in view of Watts further in view of Rose further in view of Jezzard has already been shown to teach all claim 1 limitations.

Jezzard further teaches the method of claim 1 further comprising the step of playing out a series of zero-encoding pulses during the predetermined period of time (see Jezzard, p. 434, section 6.2 "Non-Steady State Effects", and equations 11 and 12) in order to allow "enough dummy excitations (scans) of the spin system" so "that the spins may attain a steady state" as well as minimize or eliminate any "substantial artifacts" or "Fourier Noise" in the reconstructed image that could potentially result from non-steady state conditions.

Therefore, Misretta in view of Watts further in view of Rose further in view of Jezzard teaches all claim 4 limitations.

6. Claims 6, 11, 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,713,358 to Misretta (Misretta) in view of US Pat. No. 6,815,952 to Rose (Rose).

In Reference to Claim 6

Misretta teaches "an MRI apparatus comprising:

a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field (see figure 1, reference marks 139 and 141) and an RF transceiver system (see figure 1, reference mark 150) and an RF switch (figure 1, reference mark 154) controlled by a pulse module (figure 1, reference mark 121) to transmit RF signals to an RF coil assembly to acquire MR images (figure 1, reference marks 141 and 152); and

a) a computer programmed to (see figure 1, reference mark 107 and column 5, lines 25-30):

b) segment k-space into a center region and

a number of peripheral regions (see figure 4);

c) determine a distance of each peripheral region from the center region (see figure 5);

d) sample an MR signal to fill the center region at a faster sampling rate than used to sample each peripheral region (see figure 5 and column 7, lines 29-67 and column 8, lines 1-65);

As discussed earlier for claim 1, Misretta does not explicitly teach "delay sampling of the MR signal to fill the center region as a function of the distance of an immediately preceding sampled peripheral region from the center region ", but Rose does disclose this dependence of k-space center MR signal sampling on the distance of "an immediately preceding sampled peripheral region from the center region" (see Rose column 3, lines 35-67, column 7 lines 8-30, claim 12 and claim 1 rejection).

Therefore, Misretta in view of Rose teaches all claim 6 limitations.

In Reference to Claim 11

Misretta in view of Rose has been shown to teach all claim 6 limitations. Misretta further teaches "wherein a first peripheral region is closer to the center region than a next peripheral region" (see figure 4, and column 8, lines 1-21).

Therefore, Misretta in view of Rose teaches all claim 11 limitations.

In Reference to Claim 13

Misretta in view of Rose has been shown to teach all claim 6 limitations. Misretta further teaches "wherein the computer is further programmed to acquire 3D volumetric data during passage of an intra-vascular contrast agent through a patient" (see abstract, column 3, lines 47-67 and column 4, lines 1-58).

Therefore, Misretta in view of Rose teaches all claim 13 limitations.

In Reference to Claim 14

Misretta teaches:

a) the apparatus for a "computer readable storage medium having stored thereon a computer program (see figure 1 and in particular reference marks 106-108, 111 and 112)

b) the computer program including a set of instructions that when executed by a processor causes the processor to partition k-space into a plurality of partitions wherein one partition corresponds to a center of k-space and the other partitions correspond to peripheral regions of k-space (see figure 4, reference marks 107 and 108, and column 5, lines 20 – 37 and columns 7, lines 20 – 67));

c) determine a distance from the center of k-space for each peripheral region (see column 8, lines 1-180); and

Misretta in view of Rose teaches:

d) delay the sampling of the center k-space by a predetermined value that is a function of the distance an immediately preceding sampled peripheral region is from the center of k-space (see claim 1 rejection with respect to Rose).

Therefore, Misretta in view of Rose teaches all claim 14 limitations.

7. Claims 7 – 10, 12 and 15 - 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,713,358 to Misretta (Misretta) in view of US Pat. No. 6,815,952 to Rose (Rose) and further in view of Jezzard, Peter "Physical Basis of Spatial Distortions in Magnetic Resonance Images." in: Bankman, Isaac N., Handbook

of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435; hereinafter Jezzard (Jezzard).

In Reference to Claims 7-9

Misretta in view of Rose teaches all claim 6 limitations. However, Misretta in view of Rose does not explicitly teach:

- Regarding claim 7: "The MRI apparatus of claim 6 wherein the computer is further programmed to increase the delay in sampling as the distance of the immediately preceding sampled peripheral region from the center region increases."
- Regarding claim 8: "The MRI apparatus of claim 7 wherein the increase in delay is a linear increase in delay time as the distance of the immediately preceding sampled peripheral from the center region increases."
- Regarding claim 9: "The MRI apparatus of claim 8 wherein delay time after sampling a first peripheral region is a multiple of that observed after sampling of a second peripheral region"

As discussed before in the rejection for claim 3, Jezzard teaches substantially of using a region-based delay to maintain MR signal steady state conditions and minimize image noise. It was further discussed that this delay increases or decreases in direct proportion to the distance of the peripheral region from k-space center and this satisfies the claim 7 limitation.

With regard to claim 8, the limitation is not given patentable weight barring unexpected results. It is known in the art that applying a sufficient delay, whether linear or non-linear, can achieve a desired effect; namely spin steady state and lower image noise.

With regard to claim 9, the limitation is not given patentable weight by virtue of its dependency on claim 8 and because the two regions as claimed would always have a scaled/multiple relationship to each other, regardless of whether that relationship is linear or not.

Therefore, Misretta in view of Rose further in view of Jezzard teaches all claim 7-9 limitations.

In Reference to Claims 10 and 12

Misretta in view of Rose teaches all claim 6 limitations. However, Misretta in view of Rose does not explicitly teach:

- Regarding claim 10: "The MRI apparatus of claim 6 wherein the computer is further programmed to play out a series of approximately zero-encoding pulses along one of a slice selective axis and phase-encoding axis during the delay in sampling."
- Regarding claim 12: "The MRI apparatus of claim 10 wherein amplitude of one of the zero-encoding pulses along the phase-encoding axis and the zero-encoding pulses along the slice-selective axis phase encoding gradient pulses

and slice encoding gradient pulses increases as the distance of each peripheral region from the center region increases."

As discussed before in the rejection for claim 3, Jezzard teaches substantially of using a region-based delay which can be achieved through the application of (multiple/a series of) "dummy acquisitions" (applicant's zero-encoding pulses). It is well known in the art that dummy acquisitions for 3D acquisitions commonly exhibit the phase and slice encode characteristics proposed by applicant for claims 10 and 12.

Therefore, Misretta in view of Rose further in view of Jezzard teaches all claim 10 and 12 limitations.

Note: For the purposes of examining claims 14-21, 'dummy acquisitions" as disclosed by Jezzard have been equated to applicant's zero- and minimal-encoding pulses. Barring unexpected results, examiner has considered the two encoding pulses as substantially being equivalents (e.g. they achieve same end by very similar means). Therefore, all zero-encoding pulse rejections are applicable to minimal-encoding pulse claims as well.

In Reference to Claims 15-21

Misretta in view of Rose further in view of Jezzard has been shown to teach all claim limitations in reference to k-space center sampling delay and zero/mini-encoding pulses (see prior rejections for claims 6-13).

Specifically:

In Reference to Claims 15-17

See figure 1; in particular reference marks 106-108, 111 and 112 and corresponding rejections for claims 7-9.

In Reference to Claim 18

See figure 1; in particular reference marks 106-108, 111 and 112 for computer readable medium, and Jezzard p.434 and equations 11-13 for spin steady-state maintenance by zero-encode/dummy scan or pulse.

In Reference to Claims 19-20

See figure 1; in particular reference marks 106-108, 111 and 112 and corresponding rejections for claims 10 and 12.

In Reference to Claims 21

See figure 1; in particular reference marks 106-108, 111 and 112 and corresponding rejection for claim 6 (part d).

Therefore, Misretta in view of Rose further in view of Jezzard teaches all claim 15 - 21 limitations.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Salieu M. Abraham whose telephone number is (571) 270-1990. The examiner can normally be reached on Monday through Thursday 9:30 am - 7:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eleni Mantis-Mercader can be reached on (571) 272-4740. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

8/22/07 SA

ELENI MANTIS MERCADER
SPE 3768